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EFFECTS OF CLASSROOM ENVIRONMENT ON STUDENT LEARNING.

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A STUDY WAS CONDUCTED TO INVESTIGATE THE EFFECT OF DIFFERENT CLASSROOM ENVIRONMENTS UPON STUDENT PARTICIPATION AND INTERRELATIONSHIPS. AN EXPERIMENTAL CLASS IN INTRODUCTORY PSYCHOLOGY WAS FORMED WITH AN ENROLLMENT OF 144 STUDENTS. THE DIFFERENCE BETWEEN THE EXPERIMENTAL CLASS AND OTHER CLASSES WAS THAT THE ROOM SELECTION HAD BEEN PREARRANGED ACCORDING TO CERTAIN EXPERIMENTAL REQUIREMENTS. PARTICIPATION WAS RELATED TO SUBAREAS IN EACH ROOM. RATING SCALES WERE USED TO LEARN THE REACTIONS OF THE STUDENTS TO THE ROOMS AND TO THE DISCUSSION SECTIONS. IT WAS CONCLUDED THAT PEOPLE WILL ENDEAVOR TO ESCAPE A POOR CLASSROOM ENVIRONMENT WHEN POSSIBLE. UNDER THE EXPERIMENTAL CONDITIONS MORE PARTICIPATION WAS FOUND IN DISCUSSIONS IN THE LABORATORY WITH ITS STRAIGHT ROW ARRANGEMENT OF CHAIRS THAN IN THE SEMINAR ROOM. SEATING POSITION WITHIN THE CLASSROOM ALSO MADE A DIFFERENCE IN PARTICIPATION. (RS)

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Final Report

EFFECTS OF CLASSROOM ENVIRONMENT ON STUDENT LEARNING, FINAL REPORT

Cooperative Research Project Number S-204

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1965

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Table of Contents

	Page
Introduction	2
Procedure	4
Results	9
Avoidance Behaviors and Environmental Effects	9-13
Internal Room Ecology	16
Assertiveness and Seating Postion	26
Other Evaluation Procedures	31
Discussion	37
Summary and Conclusions	44
Footnotes	47
Bibliography	48

Ecology has traditionally dealt with density and distribution of organisms but only recently has it been applied to individuals in face-to-face groups. Edward Hall uses the term proxemics to describe how man structures microspace, the distance between people in their daily transactions and the organization of space in houses, buildings, and towns (Hall, 1963). Proxemics covers the entire field of human spatial usage, although the writer prefers the more specific term group ecology to describe spatial relations in organized groups. Space usage in the classroom falls into this category but the amount of empirical research on this topic is small. Most classrooms are still designed with long straight rows facing the instructor's desk even though there is no shortage of advocates of semi-circular or horseshoe shaped arrangements. A prerequisite to the development of a sound theory of classroom environment is knowledge of classroom ecology under present circumstances. Biologists speak of studying organisms in their natural habitat; human ecologists attempt to study the organization of people in natural communities. These same questions about distribution and density can also apply to the classroom situation. The arrangement of students is a function of such factors as room density, the nature of the activity, the instructor's method of teaching, the physical dimensions and shape of the room, etc.

The interior layout of classroom space is all too often taken for granted by those who plan educational facilities as well as by those who use them. Planners lack adequate criteria of classroom efficiency, while teachers and students adopt an almost fatalistic view towards the physical plant of the school building. There is a consensus that the physical struc-

ture of a school should mirror its educational philosophy but the methods for achieving isomorphism are elusive. Laymen generally lack the vocabulary to describe the way the physical environment affects them. Psychologists tend to consider the physical environment as a background factor in contrast to the foreground or figure. Architects and designers are trained to appreciate space aesthetically, to imagine planes flowing throughout a structure. Bruno Zevi has described architecture as "great hollowed sculpture which man enters and apprehends by moving about within it."

The first goal of the present study is to examine how different classroom environments would affect student participation and the second goal is to map out the ecology of participation in different types of classrooms. These two questions, at least in the short run, can be treated independently. The biologist can ask which type of environment (biome) results in optimal growth and reproduction of a species or he might ask how a species adapts itself over the short run to a particular biome. School administrators are not only concerned with facilities which are ultimately the best for learning but also with the utilization of existing facilities. In this study we intend to assign equivalent groups of students to different sorts of classroom space, switch some of them into different rooms halfway through the semester, and observe the results.

Procedure

The research took place in the spring of 1965 but the initial planning was done almost a year earlier. This was necessary in order to locate and reserve contrasting classrooms, arrange the class schedule so that the discussion sections could change rooms with minimal disturbance, and train the observers so that observations could begin the first day of classes. The major focus of the study is on a single class in introductory psychology with an enrollment of 144 students (hereafter called the experimental class). Introductory psychology at this university is a course taken by most liberal arts students, and is generally taught in large classes of 75-250 students. The experimental class attended lectures on Mondays and Wednesdays from the Professor and then on Thursdays was divided up into six small discussion sections conducted by teaching assistants. At the outset, a ceiling of 130 students was put on class enrollment and 25 on each of the discussion sections. It was impossible to achieve these numbers exactly without being unduly authoritarian and interfering with ordinary procedures. Throughout the study, we tried to maintain natural conditions. The only difference between the experimental and other introductory psychology classes is that the rooms for the discussion sections in the experimental class had been picked according to a prearranged plan and then the student switched rooms at mid-semester. Otherwise the procedure was identical to that generally followed and from a student's standpoint, nothing was out of the ordinary.

When class enrollment has stabilized, the students were assigned to discussion sections. During the first two weeks some adjustments were made in section assignments when the number of students was too large for a particular room. Because of the confusion involved in section changes,

observations made during the first week were disregarded. Of the 144 students assigned to sections, 142 finished the semester.[1] The two students who dropped out did so early in the first six weeks. It can be concluded that attrition in the sample due to dropout was negligible. Though it had been planned originally to have 25 students in each section, it was not possible to do this without arbitrarily switching students from one section to another and interfering with students' programs. The final enrollment figures in the six sections were 19, 23, 24, 24, 25, and 26. The discussion sections were led by two teaching assistants (TAs) who met three sections each at 12 a.m., 1 p.m. and 3 p.m. on Thursday afternoons. The TAs were aware that a study of "discussion groups" was being undertaken but were told nothing of the exact nature of the study. The professor knew the entire experimental plan and gave it his enthusiastic support. There were also three observers who attended the discussion sections and recorded student participation on prepared seating charts. The observers typically sat in the rear of the room and remained inconspicuous.

At the outset of the study we debated whether to tell the teaching assistants and the students the nature of the study. It would have been possible to let everyone know that an auditor was present in the classroom who was recording the discussion. However we felt this might dampen or alter class participation to an appreciable extent. It was decided to let the observers sit in the sections as auditors and say nothing to anyone. In order to legitimize this role, the TAs were informed by the professor that it was perfectly acceptable for students to audit the discussion sections. When they were hired the teaching assistants were told "a study

of discussion groups is taking place," which was described as an effort to learn about the "group dynamics" of discussion sections. By the end of the semester both TAs guessed that the study had something to do with classroom design (mainly because of the writer's association with the project and his known interest in this field). It was the opinion of all concerned that the students were unaware that a research project was taking place. This is understandable since the "experimental class" followed exactly the model of a typical introductory class except that, in the middle of the semester, the students changed rooms. At that time they were told that there were some complaints about the rooms in some of the sections and it seemed fair to switch in the middle of the semester. We will discuss the actual switch later as well as the student comments. We were all surprised (and even saddened) at how passively the students accepted the classroom change. Students who are accustomed to seven different color IBM cards as well as arbitrary changes in faculty advisors, class hours, and course offerings are unlikely to react strongly to so small a thing as a switch in classroom after the Easter vacation.

It may be helpful to summarize the amount of knowledge about the study the various parties possessed. The professor who gave the lectures was aware of the plan from the start; the TAs knew that "a research project" was going on that involved the discussion sections but did not know its specific purposes or methods and, by their own accounts, confined their activities to their roles as discussion leaders; the three observers were told what to record in each discussion section but were never informed of the nature of the project or the goals. From the seating diagrams they

kept and from their knowledge of the writer's interest, all assumed that the project had something to do with classroom environment but they were told nothing specific. The students in the discussion sections were unaware throughout that a research project was taking place. The observers were instructed to make a distinction between voluntary and involuntary statements. In the second category are answers to questions directed to specific individuals by the TA. These were not very frequent but it still seemed important to keep them separate from voluntary statements. There was some problem in specifying the boundaries of a single statement, which could be anything from a brief question to a lengthy polemic. The following rule was used by the observers: every voluntary statement by a student will be scored as one contribution, no matter how long. If another student joins in the discussion, the first student will receive an additional score for his next contribution. Since the observers did not know the students by name and the class roll was not called, the students were not identified individually. The diagrams show only the amount of participation as a function of seating. However the observers recorded the participation of the student who participated the most during the first session and followed this student through subsequent periods.

The discussion sections met approximately 14 times. Since enrollments had not stabilized before the first class period, this session is excluded from the analysis. A few sessions were also omitted because the TA or an observer was absent or, in two instances, the class met outside. This provided approximately six sessions before the switch in classrooms and six sessions afterwards. First we will examine certain aspects of

student behavior (class participation, absenteeism, etc.) in each of the classrooms. In a later section we will turn our attention to intra-room ecology and examine in detail the locus of participation within each room. We will attempt to answer such questions as whether students in the front row contribute more than those in back, those directly in front of the instructor contribute more than those at the side, etc. In a final section we shall examine several questionaire and survey studies of classroom environment.

Results

The data can be divided into agonistic behaviors (avoidance and escape reactions) and environmentally produced effects. When avoidance is successful, we cannot study the effects of the avoided environment. This problem was of more than academic interest in the study when one instructor moved her class out of the laboratory with the intention of meeting on the lawn for the rest of the semester. Though this tells us something about her evaluation of the room (and also of the students who clamored to meet outside), it diminishes the value of a study intended to assess the effects of room environment.

Seminar Rooms versus Laboratory

1. Avoidance Reactions.

All sections assigned to the seminar rooms met there. Escape behaviors were evident in the laboratory on the first day of classes when the TA handed a note to the departmental secretary requesting a change in room. When no action by the departmental secretary was forthcoming (upon the advice of the writer), the TA on his own volition moved his class to an empty room across the hall (also a laboratory but a more quiet one) where the class met for two occasions. The second TA showed her distaste for the laboratory through comments to the students and, on the fourth session, moved her class outside with the avowed intention of meeting on the lawn from then on. Pressure from the professor induced her to meet indoors.

In the seminar rooms an average of 4.4 students was absent each session compared to an average of 4.9 in the laboratory. This difference was not significant by analysis of variance ($F=.46$, $df=1, 42$). There was a

significant increase in absenteeism during the second six weeks, from an average of 2.67 the first six weeks to 6.67 per session the second six weeks. This decline occurred in all sections and was attributed by the students to spring fever, a desire to be finished with classes as the year ended. It is considered a general campus phenomenon.

2. Environmental Effects

The observers recorded all student participation on prepared seating charts. A distinction was made between voluntary statements made by the students and involuntary answers to direct questions by the teaching assistants to specific individuals. Except where stated otherwise, participation means voluntary participation. In the two seminar rooms an average of 9.0 students participate each session compared to 10.5 students in the laboratory. This difference, which indicated more widespread participation in the laboratory was significant beyond the .05 level by analysis of variance ($F=4.49$, $df=42, 1$). Further indication of this difference comes from analysis of the percentage of students participating each session. In the seminar rooms an average of 51.8% of those present took part in the discussion each session compared to 59.4% of those in the laboratory ($F=6.18$, $df=1, 42$, $p<.05$). There is also a highly significant interaction between room order which indicates that the percentage of participation increased in all sections during the second half of the semester, although increasing proportionally more in the laboratory.

In the seminar rooms there was an average of 41.6 voluntary statements each class period, compared to an average of 39.5 statements in the laboratory. Although this difference is not significant by analysis of variance ($F=2.46$, $df=1, 42$) it is noteworthy that it is in the reverse direction from the preceeding trend. A higher proportion of people

participated in the laboratory than in the seminar, but there was greater absolute participation in the seminar room. The implication is that a few people say more in the seminar room while participation is more widespread in the straight row laboratory arrangement. These results are summarized in table 1.

An overall analysis of variance was performed on the examination scores received by the students during each six week period which showed that the classes taught by one TA averaged approximately two percentage points higher than the classes taught by the other TA. It was also found that the scores received by classes who met in the seminar rooms were approximately 1.5% higher than those meeting in the laboratory. Neither of these differences was statistically significant (F=2.91 and 2.78 respectively with df=1, 88).

Table 1

Participation in Seminar Rooms and Laboratory

	Ave. No. Students Participating	% of Students present Participating	Ave. No. Statements each Class Period
Seminar Rooms	9.0	51.8	41.6
Laboratory	10.5	59.4	39.5

Open versus Windowless Room

1. Avoidance Reactions

The section assigned to the open room always met there, although there were frequent complaints from the TA who moved there from the windowless room, which he considered brighter and more attractive. He considered the "open room" to be dark and dingy since the windows were always closed and the blinds drawn. On two occasions he tried to operate the blinds but failed to open them and gave up after that. In the windowless room, escape behaviors were shown on two occasions. One teaching assistant brought his class outside but apparently did not find it very effective so met indoors after that. In the other section, the students officially petitioned the TA to meet outside. Requests to meet outdoors were written on the blackboard by the students and the question was raised in class several times. Pressure from the Professor kept the TA meeting her classes in the assigned room.

In the open room an average of 5.8 students was absent each session compared to an average of 6.17 in the windowless (p = n.s.). There was a highly significant increase in absenteeism during the second six weeks in both sections from an average of approximately four per session to eight per session during the second half semester.

2. Environmental Effects

In the open room an average of 9.33 students participated in each session campared to 9.25 students in the windowless room. During the second six weeks there was a significant decline in participation in both sections ($F = 11.99$, $df = 1, 20$, $p < .01$). The percentage of people participating was approximately the same in both rooms and showed no

significant change from one mid-semester to the other.

In the open room there was an average of 28.8 voluntary statements each class period compared to an average of 24.5 in the windowless room. This difference was not significant by analysis of variance ($F = 2.02$, $df = 1, 20$).

There were no trends in the students' examination scores that could be attributable to the change in classrooms. Those students who went from the open to the windowless room dropped slightly less than 1 percentage point from the overall class mean, while those who went from the windowless to the open room dropped two percentage points.

Table 2

Participation in Open and Windowless Room

	Ave. No. Students Participating	% of Students present Participating	Ave. No. Statements each Class Period
Open Room	9.33	47.5	28.8
Windowless Room	9.25	50.2	24.5

Internal Room Ecology

In the preceding section, participation and escape behavior were related to classroom environment. Now we turn from a comparison of rooms to an examination of the internal ecology of each room and its connection to classroom participation.

A. Old Seminar Room. Two seminar rooms were used in the study and these are called respectively, the old and new seminar room. The old room was 28'x 24' and contained a horseshoe shaped arrangement of tables and chairs in addition to several chairs along the walls of the room (see Figure 1). In this arrangement we are interested in comparing the participation of students at the side tables with those directly opposite the instructor and those away from the table. Two discussion sections met in this room, one during the first six weeks and the other during the second six weeks. Table 3 shows that the average number of voluntary contributions per session was 1.63 per person at the side tables, 2.42 at the table directly opposite the TA, and 0.64 away from the table. An analysis of variance yielded a significant F ratio for the three groups ($F = 4.04$, $df = 139, 2$) and subsequent t tests showed that the significant difference was between the students sitting directly opposite the instructor and those away from the table ($t = 2.82$, $df = 77$, $p < .01$). Attendance was lower during the second six weeks and a total of only four students occupied chairs away from the table. This small number precluded an overall analysis of participation at all three locations. Instead a t test was used to compare participation from students at the side tables with those directly opposite the instructor. Due to the large variability in individual participation, the resulting t ratio was significant at only the .20 level. The skewness of the data

Date Time Section 206A Rdhouse

TA OBS

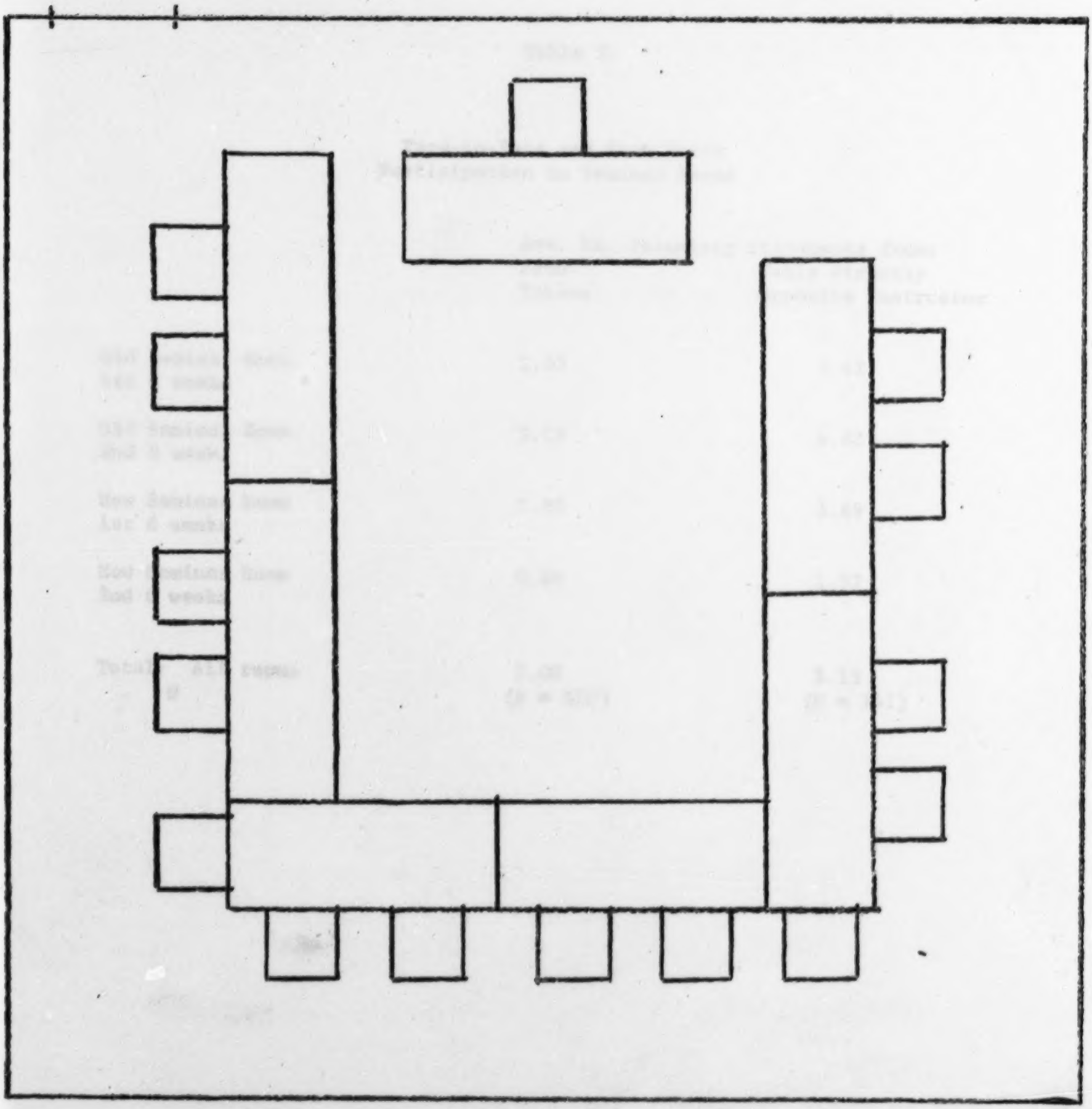


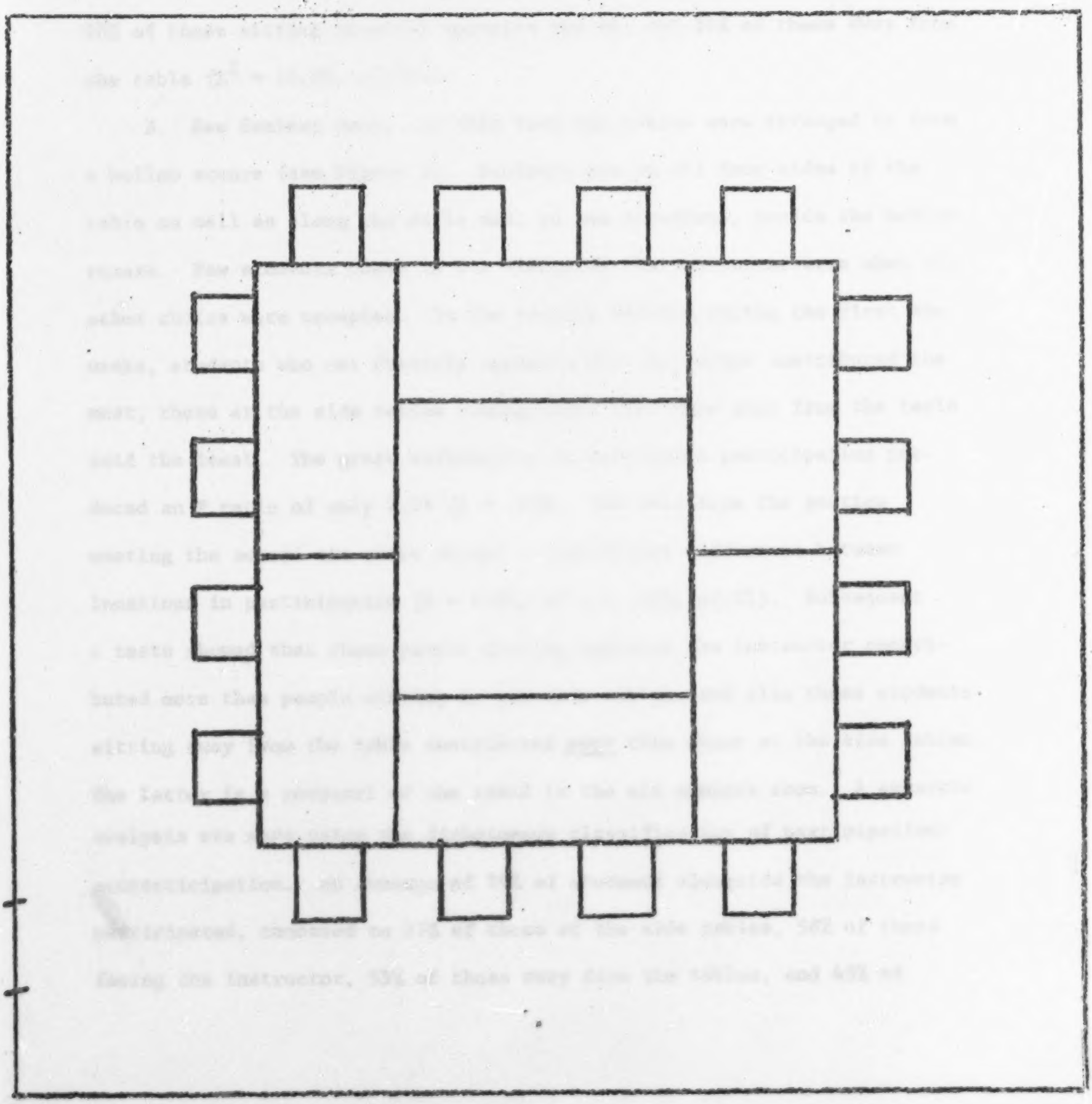
Table 3.

Face-to-Face and Side Table
Participation in Seminar Rooms

	Ave. No. Voluntary Statements from: Side Tables	Table directly Opposite Instructor
Old Seminar Room 1st 6 weeks	1.63	2.42
Old Seminar Room 2nd 6 weeks	3.19	4.62
New Seminar Room 1st 6 weeks	2.89	3.69
New Seminar Room 2nd 6 weeks	0.88	1.97
Total: All rooms N	2.08 (N = 226)	3.15 (N = 141)

Date Time Section 141 Olson

TA Obs



is apparent when it is realized that the median and modal participation per session was one statement per student while the range was from 0 to 40. For this reason the participation data were also dichotomized into a simple participation-nonparticipation classification. An average of 57% of those students at the side tables took part in the discussion, compared with 60% of those sitting directly opposite the TA, and 26% of those away from the table ($\chi^2 = 14.85$, $p < .001$).

B. New Seminar Room. In this room the tables were arranged to form a hollow square (see Figure 2). Students sat on all four sides of the table as well as along the walls and, on two occasions, inside the hollow square. Few students chose to sit alongside the instructor even when all other chairs were occupied. In the section meeting during the first six weeks, students who sat directly opposite the instructor contributed the most, those at the side tables coming next, and those away from the table said the least. The great variability in individual participation produced an F ratio of only 1.25 ($p = .25$). The data from the section meeting the second six weeks showed a significant difference between locations in participation ($F = 4.81$, $df = 2, 105$, $p < .01$). Subsequent t tests showed that those people sitting opposite the instructor contributed more than people sitting at the side tables, and also those students sitting away from the table contributed more than those at the side tables. The latter is a reversal of the trend in the old seminar room. A separate analysis was made using the dichotomous classification of participation-nonparticipation. An average of 24% of students alongside the instructor participated, compared to 37% of those at the side tables, 58% of those facing the instructor, 53% of those away from the tables, and 45% of

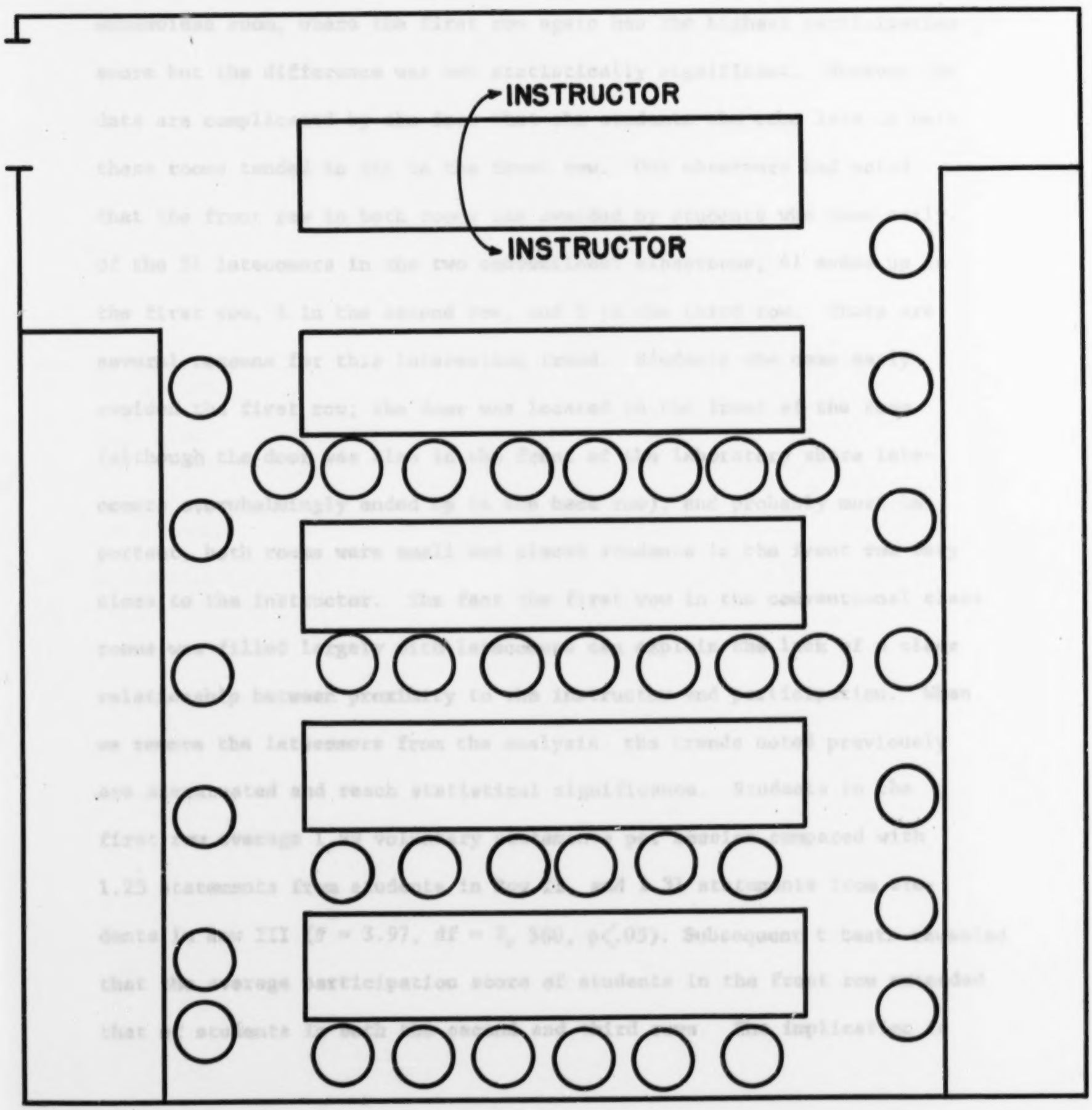
those inside the table ($X^2 = 11.54$, df = 4, $p < .05$).

From the standpoint of small group theory, it is interesting to compare those students directly opposite the instructor with those at the side tables. The emotional and expressive value of direct visual contact has been the basis of much theorizing by anthropologists and sociologists (Birdwhistell, 1952 and Goffman, 1963). In his study of discussion groups Steinzor (1950) found that when one person stopped speaking, it was the person directly opposite him who usually spoke next. Before the present study began, it was explicitly predicted that students directly in front of the instructor would participate more than those "in the wings." This was found to be the case in all four sections meeting in seminar rooms (see Table 3). The pooled data show an average of 3.15 voluntary statements from students sitting directly opposite the instructor compared to an average of 2.08 statements per session from students sitting at the side tables ($t = 2.29$, df = 365, $p < .05$). Pooling the probabilities from the four groups meeting in this room according to the method proposed by Mosteller and Brush (1954) results in a higher probability ($z = 2.59$, $p < .01$). Using the dichotomized participation-nonparticipation scores, an average of 47% of the students at the side tables participated compared to an average of 59% of those directly opposite the instructor ($X^2 = 4.97$, df = 1, $p < .05$).

C. Laboratory. This room was selected as an extreme example of a straight row arrangement (see Figure 3). This room first came to the writer's attention when he passed by one afternoon and observed the instructor dissecting a rabbit at the front table. The students in the front row leaned forward on their stools to see their instructor. The

students in the second and third rows were standing on top of the second row of tables peering down. Since the tables could not be moved, this seemed an excellent example of a straight row arrangement. We still had to reckon with the ingenuity of our TAs, one of whom typically sat at the front of the instructor's desk rather than behind it and the other who encouraged her students to bring their stools up to the front bench in a vain attempt to approximate a semi-circular arrangement. The high tables resisted her efforts and a straight row arrangement prevailed in all discussion sections meeting in this room. From an ecological standpoint the main item of interest is the connection between row and participation. On the basis of the expressive contact hypothesis, that visual contact increases interaction, it was predicted that students in the first row would participate more than students in the second row, etc. This was confirmed by an analysis of variance on the participation scores. Subsequent t tests indicated that participation in Row I (3.20 statements per session) was significantly greater than participation in Rows II and III (1.23 and 1.86 statements respectively). It was also found that the students seated at the sides of the room participated more than those in the second row ($p < .05$). A nonparametric analysis showed that an average of 71% of students in the first row participated each session compared to 49% of those in Row II, 51% in Row III, 54% in Row IV and 82% of those at the side tables ($\chi^2 = 24.53$, $df = 4$, $p < .001$). The fact that students in the front row and those at the side tables participated the most is consistent with the expressive contact hypothesis, since these students were the only ones who had a clear and relatively unobstructed view of the TA.

LABORATORY



D. Conventional classrooms. The "open room" was a small classroom with four rows of chairs facing the instructor. Table 4 shows that students in the front row contributed more than students in the other rows, but this was not a significant difference. The same holds true in the windowless room, where the first row again has the highest participation score but the difference was not statistically significant. However the data are complicated by the fact that the students who came late in both these rooms tended to sit in the front row. Our observers had noted that the front row in both rooms was avoided by students who came early. Of the 51 latecomers in the two conventional classrooms, 41 ended up in the first row, 5 in the second row, and 5 in the third row. There are several reasons for this interesting trend. Students who came early avoided the first row; the door was located in the front of the room (although the door was also in the front of the laboratory where latecomers overwhelmingly ended up in the back row); and probably most important, both rooms were small and placed students in the front row very close to the instructor. The fact the first row in the conventional classrooms was filled largely with latecomers can explain the lack of a clear relationship between proximity to the instructor and participation. When we remove the latecomers from the analysis. the trends noted previously are accentuated and reach statistical significance. Students in the first row average 1.99 voluntary statements per session compared with 1.25 statements from students in Row II, and 1.31 statements from students in Row III ($F = 3.97$, $df = 2, 380$, $p < .05$). Subsequent t tests revealed that the average participation score of students in the front row exceeded that of students in both the second and third rows. The implication is

Table 4

Participation by Row in Conventional Classrooms

	Ave. No. Voluntary Statements from:			
	Row 1	Row 2	Row 3	Row 4
Open Room 1st 6 weeks	2.30	1.88	1.45	0.80
Open Room 2nd 6 weeks	1.25	0.76	1.20	1.10
Windowless Room 1st 6 weeks	1.00	0.78	0.97	---
Windowless Room 2nd 6 weeks	2.38	1.57	1.78	---
Total: All Rooms	1.77	1.23	1.32	0.95
N	(144)	(162)	(128)	(20)

clear that the trend for the first row to produce greater participation is weakened by the influx of latecomers into this row.

The two conventional classrooms provide the reverse situation to the laboratory where, because of the noise and high tables, the choice seats were in front. Of the 41 latecomers in the laboratory, 4 ended up in the first row, 1 in the second row, 17 in the third row, 10 in the fourth row, and 9 on the sides of the room. Removing the latecomers' participation scores in the laboratory does not materially alter the trends. We still find 71% of students in the front row participating compared to approximately 50% of the students in the other three rows. This suggests that the relationship between location and participation must take initial choice into account. When the favorable seats are in front, there is a compounding of the greater stimulus value of the instructor reaching the most interested students which results in a strong relationship between the front seats and increased participation. When the favorable seats are in the middle or rear of the room, the increased expressive value of the instructor for students in the front row will tend to cancel out the fact that the most interested students are found in the other rows, and there will be no clear relationship between row and participation.

Assertiveness and Seating Position

Since the observers did not know individual students by name, it was impossible to record individual contributions. The situation was made even more difficult by the fact that the class roll was never called. Any prospect of identifying individual students was abandoned in the beginning. However some interesting research with animals has shown

that the dominant individual has "freedom of space." Davis (1959) and Shoemaker (1939) have demonstrated that animals change from territorial behavior to a dominance hierarchy when space is restricted. Both mechanisms protect the group against constant fighting since they permit each individual to know his place, either geographically or in the social hierarchy. Esser (1965) in a fascinating study of hospitalized mental patients, has identified behaviors he feels are comparable to dominance relationships in the animal kingdom. The alpha patient on the ward has "freedom of space" and can go where he wants. The other patients are unlikely to usurp his place or crowd him out. On the basis of this work, it seemed worthwhile to examine the behaviors of the most assertive individual in the class. Even though his name was not known at the outset, he could be followed throughout the semester and perhaps identified later.

On the first day of class, each observer selected the one student in each section who participated the most. This student was identified by an arrow on the seating charts. As can be imagined, selecting students on the basis of the first session's participation did not always yield the individual who was most assertive later on. In two discussion sections no single student stood out and this procedure was omitted. This left four discussion sections in which the behavior of the student who was most assertive the first period was "tracked" throughout the semester.

1. Phillip. On the first day in the old seminar room Phillip sat directly opposite the TA and participated 15 times. During the next four sessions, he sat either in that chair or in chairs immediately adjacent to it, never varying more than one chair from "his place" and his voluntary participation during these sessions was 8, 8, 15 and 11

statements respectively. Phillip was absent on March 18. When he returned to class on March 25 he apparently had "lost his place" and he sat at the far table on one side of the room. His contribution at this time was 4 voluntary statements about half his usual rate. Next period the class met in the laboratory where Phillip occupied a seat in the front row the first day, the seat next to it the second day, and a seat 2 seats over the following day. On all three sessions his contribution was 6 voluntary statements. He stopped attending the discussion sections after that.

2. Edward. During the first session, he sat at the center of a side seminar table and his participation was 13 voluntary and 6 involuntary statements. During the 6 subsequent sessions in this room he sat in this particular chair or 1 chair over and his participation was 2, 12, 17 (plus 1 involuntary), 7, 13, and 3 voluntary statements respectively, The class moved into the laboratory next session at which time Edward sat alongside the wall and made 5 voluntary and 1 involuntary statements. He talked to his neighbor repeatedly and was finally asked to leave by the instructor if he couldn't stop talking. His behavior during the session troubled the TA who mentioned it afterwards. Apparently the incident affected Edward also because on subsequent sessions he moved back to the second row and sat in a center chair one period, two chairs over the next, four chairs over on the other side the next two times, his contribution dropping to 2, 1, 0, and 1 voluntary statements respectively.

3. Sandy. On the first day of classes, it was apparent that this student who came in late was previously acquainted with the TA since the student was called on by name several times. The class met in the laboratory which had the noisy refrigerator in the rear. During the first

session Sandy sat in the last row and made six voluntary and 4 involuntary statements. On the following periods he also sat in the back row two seats away from his previous seat, contributing 7 voluntary (and 4 involuntary) statements and 10 voluntary (and 3 involuntary) statements respectively. In the next period he sat in the third row, making three voluntary statements. The next class he sat in the first row and made 6 voluntary and one involuntary statement. In the next class when the TA moved the class into the laboratory across the corridor to avoid the noisy refrigerator in the rear of the old room, this student was late and sat in the back row adjacent to where he would have sat before in the old room and he contributed 10 voluntary statements. The class moved into the seminar room; Sandy began by coming late, and ended up sitting in a chair inside the hollow square and made four voluntary statements. On the next class the TA was busy grading examinations and arrived late. Sandy started the class, occupying the TA's customary chair, and continued reading exam questions after the TA arrived. Toward the end of the hour when the TA assumed his customary role, Sandy made two voluntary statements. At the next session Sandy was on time. He sat at the tables directly across from the TA and made 5 voluntary statements. He was late again next session and sat at the right corner of the table facing the TA and made 6 voluntary statements. For the next two sessions he was on time and sat at the table directly across from the TA, one and two seats respectively from where he had sat earlier. On each of these two sessions he made 4 voluntary and 1 involuntary statement. On the final day of classes Sandy was late again. Due to the influx of students wanting to learn about the final exam, all chairs

were occupied. Sandy sat on the floor at the right corner of the table where he previously sat on another occasion when he had come late. This time he made 6 voluntary statements. Sandy's behavior is compounded by a number of factors which include his prior acquaintance with the TA, his frequent lateness (5 out of 13 sessions), the noisy refrigerator in the laboratory, and the crowded conditions in the new seminar rooms when all students attended. If one takes these factors into account, there is still considerable stability in his choice of seats. In the laboratory he sat in the fourth row 4 out of 6 times. On all three days when Sandy came to the new seminar room on time (except for the session when he was acting teaching assistant) he occupied one of three adjacent chairs at the table facing the TA. On two occasions when he was late he sat in the right corner of the room facing the TA and the other time he was late he occupied an empty chair inside the tables. Taking into account these complicating factors, Sandy's preferred position was in the back row of the laboratory and directly opposite the teaching assistant in the seminar room.

4. Ginny. At the first session, she sat in the second row towards the center of the room and made four voluntary and 6 involuntary statements. She occupied the same chair during the next session and contributed 11 voluntary and one involuntary statement. The next period Ginny sat in the third row and left early; she made no voluntary statements during that time. During the next two sessions she returned to her original chair and made 10 voluntary (plus 1 involuntary) and 8 voluntary statements respectively. Following this session, the student stopped coming to class.

Other Evaluation Procedures

Architecture most frequently affects people from beyond the focus of awareness. This has made it necessary to devise special techniques for assessing people's reactions to their surroundings. There have been several attempts (Berger and Good, 1963; Sommer, 1965) to use Osgood's Semantic Differential for psycho-architectural studies. This technique was developed at the University of Illinois to explore connotative meanings, the subjective personal definitions that people apply to concepts. A building is a certain height, color, and style but it also appears to people as warm or cold, ugly or beautiful, useful or useless, etc. Using the complex tools of factor analysis, Osgood (1957) reduced the main connotations to three major dimensions--value (as expressed in the good-bad scale), potency (as expressed in the strong-weak scale) and activity (as expressed in the active-passive scale).

The emphasis in the present study was on the objective recording of behavior, but it also seemed worthwhile to learn the students' personal definitions of each classroom. The semantic differential was administered in each section during the eleventh week of the study. The students rated two classroom buildings and the library reference room first (which were included to camouflage the purpose of the instrument) and then rated "This Classroom" on nine separate scales. There were many surprises in the ratings. All five rooms came out on the ugly side of the ugly-beautiful continuum. In fact the extreme beautiful end of the continuum was never used by any student. Some later discussion with students revealed that no classroom on campus was considered really beautiful. Maybe this should not have been a surprise since the classrooms lack pictures, rugs,

plants, flowers, and most of the other amenities that make a room appear friendly and attractive. We do not imply that classrooms should resemble homes but only that bare walls and shiny tile floors have an institutional look that repels most people. The laboratory was high on value probably due to its association with science; it was also the largest and strongest of the rooms. The next highest room on size and strength, as well as the highest on activity, was the starkly modern windowless room. The "open room" which was chosen in consultation with the design department but whose windows were always shut and blinds drawn was rated the ugliest of the rooms as well as lowest on the activity dimension. The new seminar room received the most favorable ratings on the ugly-beautiful scale although it was still slightly in the ugly direction. The old seminar room was lowest on the potency dimension and low on activity. These ratings virtually rule out the idea that we were dealing with a simple ugly-beautiful continuum with these five rooms.

Another reason for the paucity of behavioral studies in architecture is the belief that people are extremely adaptable and almost any design solution will suffice from the standpoint of the occupants' behavior. This attitude was illustrated by the statement of a university architect with whom the study was discussed. The man stated quite frankly "It doesn't matter what kind of classrooms you give them, there'll be a few complaints in the beginning but after six months they'll die down." There was a great furor among students and faculty when the building containing the windowless classrooms was first opened. These particular rooms, one of which was included in the study, were the subject of many acid comments in the student newspaper.[2] However not a single remark on the student evaluation sheets (to be described shortly) mentioned the windowless room,

its stark decor, or green wall. This does not mean that the students necessarily liked these aspects of the room. When the students were asked to rate this room (and the others) they ended up on the ugly side of the ugly-beautiful continuum. It does mean that feelings about the environment are generally of low saliency. On the day the classes switched into their new rooms, our observers recorded these comments:

> (Laboratory, 12 o'clock session) "They must be kidding!" "Is this the right room?...Are you sure?" "Oh come on...is this a joke?!" Almost every student has a look of astonishment as he entered--including the observer! Aside from the remarks, many students just sort of laughed and exchanged looks, and shrugged their shoulders. "I guess this is why we switched!" When the TA entered, she laughed and said "Oh no, this is ridiculous!" She then asked everyone to move up into the first couple of rows, to crowd in together...there were also comments that "So this is why the rooms were changed!" and "No wonder the other class didn't like this room."
>
> (Laboratory--1 o'clock session) TA asked group to crowd around the first table. Much whispering in class, and the class openly resented the room change.
>
> (Old seminar room) Atmosphere more relaxed...
>
> (New seminar room) When the TA came in, someone mentioned April Fool's. One boy said "it must be when they gave us this room."
>
> (Windowless room) When the TA first came in, she said "Well, I see we've all made it to the dungeon."
>
> (Open room) When the students first entered the room, there were a few voiced complaints about the room--"I can see why the other class wanted to change. This room is really dingy." "Yeah, the

rooms in this building are pretty bad." "What an ugly room." Someone suggested that since the switch had taken place in mid-semester it was probably to let each class have half the semester in the good room (i.e., windowless room) and half in this room. When the TA entered, he suggested that the blinds be opened. After they were, the room brightened up considerably and students who entered after that made no comments about the room, nor did anyone make further comments.

The depth of these feelings can be gauged from the fact that four weeks later when the students filled out evaluations, only two specifically mentioned classroom environment. The evaluation form, filled out anonymously in the last day of classes provided a place where students could write comments. More than half the students availed themselves of this opportunity to comment but only two mentioned the classroom environment. One wrote "the seminar tables are more conducive to discussion" while a student in the laboratory wrote that "A better environment could be provided. Labs are not particularly conducive to comfort or class participation. I would suggest a round table discussion-type thing."

The discussion sections were well-received by students, teaching assistants, and instructor and from all indications accomplished their designated purposes. This statement is justified, not only on the basis of students' evaluations but on the records of student participation. During each 50-minute class session, the average number of students voluntarily participating was 9.6 each period or an average of 54% of those students present. If we look at the total amount of discussion regardless of the number of people participating, we find an average of 36 voluntary statements and 3 involuntary statements during each 50-minute

class period. We have no basis for evaluating the quality of the discussion but there is no doubt the discussion was active and widespread. Further support for this assertion comes from a discussion section in another class that one of our observers attended.

During the 11 sessions observed, the average number of students participating voluntarily was 2.8 students per session or 12% of those present and these students contributed a total of 4.6 voluntary and 0.3 involuntary statements per 50 minute period. Additional information on the value of the discussion sections for the students comes from the evaluation forms filled out anonymously by those students present at the last session of class. The students were asked to rate the discussion sections along five dimensions using scales from 1 (excellent) to 5 (very poor). The average ratings for all six sections were: relevance of material 3.96; general class participation 3.13; motivation to attend 3.29; motivation to participate 3.07; Teaching Assistant 3.93. The adjectives from a prepared list checked most often by the students to describe the discussion sections were "informative" and "relaxed."

A final indication of the value placed on the sections by the students was the simple fact that attendance throughout the semester averaged 80% (despite a serious outbreak of spring fever during the second half of the semester). This was true even though the roll was not taken and no exams were given that contributed to the students' final grade.

These indications of the success of the discussion sections (student evaluations, amount of discussion, and the satisfactory voluntary attendance) have some implications from a pedagogical standpoint. The two discussion leaders had just finished their B.A. requirements the previous semester

and neither had prior teaching experience. What they lacked in background and training they made up in enthusiasm and interest in the task. Each attended all the lectures given by the professor faithfully and had a strong emotional committment to succeed in the new role. Since their subject matter knowledge was limited, they took their roles as <u>discussion leaders</u> seriously. Had they known more, they might have done less well in developing student participation.

Discussion

We have seen that the first line of defense against a poor environment is avoidance. Assigning people to the laboratory and the windowless classroom produced immediate and vociferous flight reactions. However when the classes were compelled to meet in this environment, we find that participation is higher than, for example, in the seminar rooms. It seems likely that the tension aroused by the unpleasant environment, the inability to slouch back or be comfortable on the laboratory stools, tended to increase participation. This suggests a hypothesis that, if confirmed, can explain some of the seemingly contradictory results of environmental studies, e.g. research in offices and factories that shows a positive relationship between noise level and productivity. It is suggested that a poor environment increases avoidance by those able to escape but increases activity level among those present. An implication of the study is that a comfortable environment isn't necessarily the one most conducive to active discussion. The stereotype of a heated discussion shows people leaning forward in their chairs, perhaps with their elbows resting on a table. This image bears more resemblance to the situation in the laboratory with the students on stools which made it impossible to lean back than to the situation in the seminar room with soft chairs and people able to relax.

The implications of this are complex since we doubt very strongly that it means an unpleasant room is superior to a pleasant room for group discussion. Rather it means that a motivated and imaginative instructor can use unsuitable facilities for discussion purposes. One TA tried to approximate a semicircle in the laboratory by bringing all students up to

the first rows, but in the end conceded defeat since the high tables proved too much for her. The other TA tried to reach his students by sitting in front of the desk rather than behind it. However the goal of classroom design is not to build for heroes who can triumph in spite of poor architecture. We have no indication of the price paid by the TA or the students to maintain the discussion in this room. Just as studies have shown that productivity can be maintained despite noise but in the long run the gain is offset by higher absenteeism, sickness, and turnover, the deleterious effects of bad environment may be insidious and subtle The relevance of this can be seen in the fact that only two students in the entire class mentioned the room environment in their course evaluations. On the other hand, we have seen that providing adequate classroom facilities does not guarantee that they will be used. This was evident in the so-called open room which had been recommended by the design faculty as light and airy but in fact proved to be dark and dismal since the blinds were drawn most of the time. Ironically the students who had moved here from "the dungeon" believed they had got the worst of the trade.

The sketchy data concerning individuals who were followed throughout the semester are intriguing. It is no surprise to find that students are consistent in their choice of seats or areas within a room, but the way that choice of seat can be affected by social factors within the classroom is terra incognita. In two cases, we have seen how small incidents such as absence or rebuke by the dominant individual (in this case the instructor) was enough to lower a person's position in the class to the extent where he "lost his place" and reduced his participation in the discussion. Space and status are intimately connected in human and animal communities. McBride (1964) has shown that the dominant bird of a flock goes where he

wants and the others look aside and move away at his approach. When a subordinate wanders around the group, the other birds neither look aside nor look away, and may physically assault him. The role of density or crowding must be taken into account in discussing status. Although Sandy was undoubtedly the alpha student in his section, when he came late and all the chairs were occupied, he ended up sitting on the floor. If there were many empty chairs in this room, it is likely that the other students would have left "Sandy's chair" vacant for him. Most people have had occasion to sit in on meetings or conferences and be told politely but firmly, "This is So-and-so's chair." Just as the use of hormones or tranquilizers can alter an animal's position in the dominance hierarchy, so can rebuke by the dominant individual (the teacher or instructor) change a student's role in the classroom status system.

The results have shown clearly that there is a relationship between classroom seating and participation. One unanswered question is how much of this is due to selection of seats according to interest in the material, how much is due to the effects of the location itself, and how much to an interaction of these two factors. Several recent studies of small group ecology show that initial choice of seats is far from random. Studies of discussion groups have shown that leaders typically chose the head position at the table (Sommer, 1961; Strodtbeck & Hook, 1961). It should be noted that these studies were carried out in North America. Hall suggests that the ecology of leadership in other countries is different. The French administrator typically sits in the midst of his subordinates while the American tends to be physically removed from them. Strodtbeck and Hook who studied seating patterns during the experimental jury deliberations, found that jurors at the head of the table participated more than jurors at

other locations and were rated by their fellow jurors as having more influence on the outcome of the deliberations. These people were also more likely to be elected foreman than people sitting in other parts of the table. However it would be unwise to attribute this greater influence solely to seating position since jurors from professional and managerial jobs gravitated to the head positions of the table while jurors of lower status chose the side positions. This confounding of location and status suggests that the initial choice of seats in a classroom is not random. It is an interesting (but apparently untested!) hypothesis that the most motivated students sit in the front row or directly facing the instructor in a seminar-type arrangement. There are several ways of disentangling initial choice from location as an influence on participation. One is to require students to sit in alphabetical order or in some random fashion. Then any difference between first and last rows or between middle and side seats can be attributed to location rather than initial choice. Another solution is to let students sit where they wish, but at some point gauge each student's interest in the class. Students in each row can be matched according to degree of motivation and their participation compared with motivation equated.

Further light on classroom ecology would be shed by diagrams showing how rooms fill up. We have found this data very useful in studies of seating patterns in study areas. When the room first opens, individual tables are occupied until room density reaches approximately 1 per table. Then newcomers must sit at tables already occupied, and typically use a "distant" or catty-corner arrangement so that they do not face or sit alongside the present occupant. In the classroom, habit undoubtedly plays a part in determining a student's choice of seats. On those occasions

when we have followed individual students for extended periods, they typically sat in the same general area. Personality factors and existing friendships influence seating on the first day of classes. Frequently the room geography makes certain areas more desirable than others, as was the situation in the laboratory where hearing and seeing was difficult from the rear and only the latecomers ended up in these seats. It also seemed the situation in the small classrooms where the front row seemed "too close" to the instructor.

From a practical standpoint it is exceedingly important to teach instructors to use classrooms to their maximal effectiveness. Just as a teacher must learn how to use audio-visual equipment properly, the classroom setting provides many features that can enhance or detract from the daily program. The writer has assisted colleagues who were having difficulty in maintaining participation by focusing attention on the way they were using classroom space. It may be relevant to mention that the writer first became interested in environmental studies when he worked on a hospital geriatrics ward. It soon became apparent that the internal arrangement of the ward, straight rows of chairs against the walls, prevented the elderly ladies from conversing. When we rearranged the chairs around small tables, we found that interaction between the ladies more than doubled. The same considerations apply in the classroom although it may take some imagination and study to learn how to use each facility for any given purpose. There is no single best arrangement for all classroom tasks. For individual study, a sociofugal arrangement that minimizes eye contact may be preferred while in small group discussions a circular or sociopetal arrangement may be best. Following Frank Lloyd Wright's

dictum that ~~structure~~ function should determine ~~function~~ structure, we can say that task should determine arrangement rather than the arrangement of students determining what they do.

Another goal of the study was to explore the possibilities of environmental research using intact school classes. For some years the writer had been intrigued by the research possibilities of large introductory classes meeting in parallel sessions. In some large universities there can be 40 or 50 sections of beginning English meeting each semester. The use of equivalent classes taught in different environments would permit exploration of many important questions. In fact the writer had been curious as to why so little research of this sort took place. The major reason seemed to be the numerous administrative and technical difficulties in field research of this sort, a fact which became readily apparent in the course of the study. There were some very discouraging moments during the present study, particularly in the beginning when it was necessary to juggle room schedules, instructor assignments, observer assignments, and class enrollment. These administrative arrangements took as much time and travel as the design of the study and analysis of the data. This seems a necessary characteristic of environmental research that uses existing facilities. Just as no ecological niche in nature will remain unoccupied for long, any room in a school building, hospital, office or dormitory will be occupied. This makes it necessary to reserve experimental spaces long before the study is to take place and to involve the people who own or assign space in the study. It would have been much simpler to conduct the entire study in facilities under the jurisdiction of the Psychology Department. There was one particular classroom under our jurisdiction and the chair arrangement could have been altered from one session to another. However, we

would have lost the great contrast in rooms that was obtained by going out in the field and selecting those already in use that varied in specific ways. The long-range solution to this problem is to develop frankly experimental building facilities. Schools are presently being built with movable partitions which enable rapid and inexpensive change from a "closed" to a "open" plan. The reasoning behind these buildings is the liklihood of change in educational philosophy, but they also present marvelous opportunities for environmental research.

Summary and Conclusions

Six discussion sections of a large introductory psychology class were assigned to different classroom spaces which they occupied for six weeks before switching to different rooms. Two rooms contained seminar-style arrangements while one was a laboratory with fixed tables and stools; one room was windowless and the other had an entire wall composed of windows. At midsemester students from the seminar rooms moved into the laboratory and those from the laboratory into the seminar rooms, while those from the open room went into the windowless room and vice-versa. All discussion in the rooms was recorded by an observer.

Avoidance reactions were evident in the laboratory and in the windowless room. The instructors tried to change classrooms through official channels and when this failed, attempted to meet their classes outside. Student participation was more widespread in the laboratory than in the seminar room. An average of 51.8% of the students in the seminar rooms took part in the discussion compared to 59.4% of those in the laboratory, a difference which was statistically significant. However there was a greater amount of total discussion (although fewer individuals participated) in the seminar room. One interpretation of these results is that students in the laboratory were unable to lean back and relax (it was physically impossible on the laboratory stools) as they could in the seminar room. There were no major differences between the open room and the windowless room, except that escape reactions were evident in the latter. The participation of the student who was most assertive during the first day of

classes was followed throughout the semester. His seating was found to be stable, although certain factors such as previous absence or rebuke by the instructor could make him "lose his place."

Participation was related to sub-areas in each room. Testing the expressive contact hypothesis, it was found that in the seminar rooms, students who sat directly opposite the instructor participated more than students at the sides. In conventional classrooms with straight rows of chairs, students in front participated more than those in the other rows. However initial choice plays some part in this trend. When the most desirable seats are in front and presumably occupied by the best motivated students, the trend will emerge clearly. When the most desirable seats are in the middle or the rear of the room and latecomers or students with low motivation occupy the front rows, expressive contact and motivation will be pitted against one another and there will be only a slight connection between row and participation. Several methods of disentangling initial choice from seating position, including alphabetical or arbitrary random seating, were discussed.

Rating scale procedures were used to learn the reactions of the students to the rooms and the discussion sections. Unless the students were specifically asked about the rooms, they didn't mention them. Of the 106 students who filled in class evaluation forms on the last day, only two voluntarily mentioned classroom environment. However during the course of the semester, particularly on the day of the classroom switch, the observers recorded many comments about the classrooms. The notion that the physical environment is generally a background variable was supported.

In conclusion, the study shows that people will endeavor to escape a poor environment if they can. If they are forced to remain, the results

can be paradoxical. In the present instance there was more widespread participation in the laboratory with its straight row arrangement than in the seminar room. It was hypothesized that this was caused by the student's inability to remove himself psychologically by leaning back in his chair or relaxing in the laboratory as he could in the seminar room. Seating position within the classroom also makes a difference in participation. However the extent to which this is tied up with initial choice of seats or the locations themselves is a matter for further research. The possibilities for further psycho-architectural research in the classroom were discussed.

Footnotes

1. One additional student who finished the course was never officially enrolled in a discussion section and no record of his attendance is available. This brought the actual total of students in the six discussion sections to 141.

2. On the humor page of the California Aggie (Nov. 5, 1963) the following reply was given to the question "What do you think of the CRB (Class Room Building)?". "Do you mean 'Claustrophobia Ready Built,' you know, instant heart attack? Those green and purple and orange walls would not be so bad, but they are all in one room! I step into the door and I immediately feel I've entered a crowded elevator."

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